ELEMENTARY STEM PROGRAM

PROJECT MANAGEMENT PLAN

By

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Abstract

This project produced a science, technology, engineering, and math (STEM) summer program. A multi-phased process was used to determine the appropriate course of action for data collection and a summer program curriculum creation. The summer program and curriculum will be used as a blueprint for improving the current elementary school program. Phase one included assessment of educator's and students' utilization of the existing STEM program, through surveys, observation, and interviews. Phase two analyzed data obtained through phase one, providing an outline of the STEM program status. Phase three used data obtained from phases one and two, creating a single, week-long summer STEM program curriculum. Standardized STEM lesson specifications along with benchmarking were utilized for curriculum creation. The summer program consists of three rotational lab stations: an outdoor exploration and discovery lab, an outdoor hands-on engineering lab, and an indoor technology-based lab. The school has committed to use the lessons learned and curriculum as a foundation for future summer camps. Lessons learned from this project were provided to the elementary school to implement and improve the current STEM program and it was successful.

Key Words

STEM, Science, Technology, Engineering, Math, Elementary, Summer Camp Curriculum, STEM curriculum

Introduction

Desires for self-improvement and discovery have been prevalent for as long as humankind has been able to formulate thoughts into a cohesive willingness to accomplish a goal. Throughout the evolution of a baser instinct to master and mold the world to our needs, we gained knowledge through observation and application. Civilizations rose and fell over several millennia, with one of the only constants that remained, the pursuit for education and continued growth. As technology and industry emerged, a need for skilled labor continues to be a driving force in education.

In 1635, the first public school was established in Boston, offering lessons on virtues of family, religion, and community ("History of Boston Latins School," n.d.). Like a form a Darwinism, educational institutions evolved to teach subjects specific to the demands of the current industries. With the advent of the industrial age, engineering became a large part of education, along with math and sciences. With this growth in industry and our constant drive to make life easier, we continue to develop technology that aids in and continually perpetuates the desire for comfort and convenience. With this growth, jobs in STEM-related fields have become a significant portion of the present-day workforce. Schools began to evolve to incorporate education that would prepare students for a future in relevant areas of employment (Honardoost, 2014).

So, what is STEM? STEM is an inquiry-based application of sciences, technologies, engineering, and math. It is a concept that has been growing in popularity in the last few decades, and one form or another has been a mainstay in middle schools and high schools, with an increasing presence within elementary schools. In the last few decades, an increase in STEM presence in elementary schools has been changing, with research and studies providing evidence on how elementary aged children process information. The correlating benefits of introducing material at a younger age with a firm educational understanding of scientific concepts, skills that are used daily, such as creative problem solving, critical thinking, teamwork and to set the foundation for continuing education. (National Science Education Standards Pg. 10). In everything that we do, we improve through practice and continued application. Skills that emerge from a subject can be perfected over time through constant use and inquiry. Children have a natural drive to learn what makes up the world around them.

Starting at birth, the brain is primed and ready for sensory inputs, in essence, it demands knowledge. The architecture or neural connections of the human brain are continually forming. The knowledge gained through life experiences is a key component for the creation of these neural connections. The Center on the Developing Child at Harvard University, states that the brain is more flexible, or plastic at a younger age, capable of absorbing a vast range of knowledge. In an article from The Center of the Developing Child, states, as we age, the brain becomes more specialized and is less adaptable to new challenges ("The Science of Early Brain Development," n.d.). You can see in exhibit 1, a graph highlighting the brain's capacity to learn at a younger age and how that changes over time. Higher Cognitive Functions are at their highest from birth through elementary and middle school ages. This further highlight that, the sooner a subject is introduced, the sooner it becomes available for application.

Unfortunately, as education systems have evolved, and new policies are put in place, the lines dictating what children are required to learn to keep moving, limiting access to the STEM-related material. Children benefit from being exposed to STEM-related fields of study at an early age, giving them the opportunity to enhance interest, along with continually build upon learned concepts over a more extended period. The focus has shifted to the more memorization-based curriculum with little to no inquiry-based applications of materials learned. A poignant quote from Center on Education Policy in 2008 further emphasizes this point by stating "Yet, as efforts to increase the quality of science education takes place, the amount of time spent on teaching science at the elementary level has continued to decline."

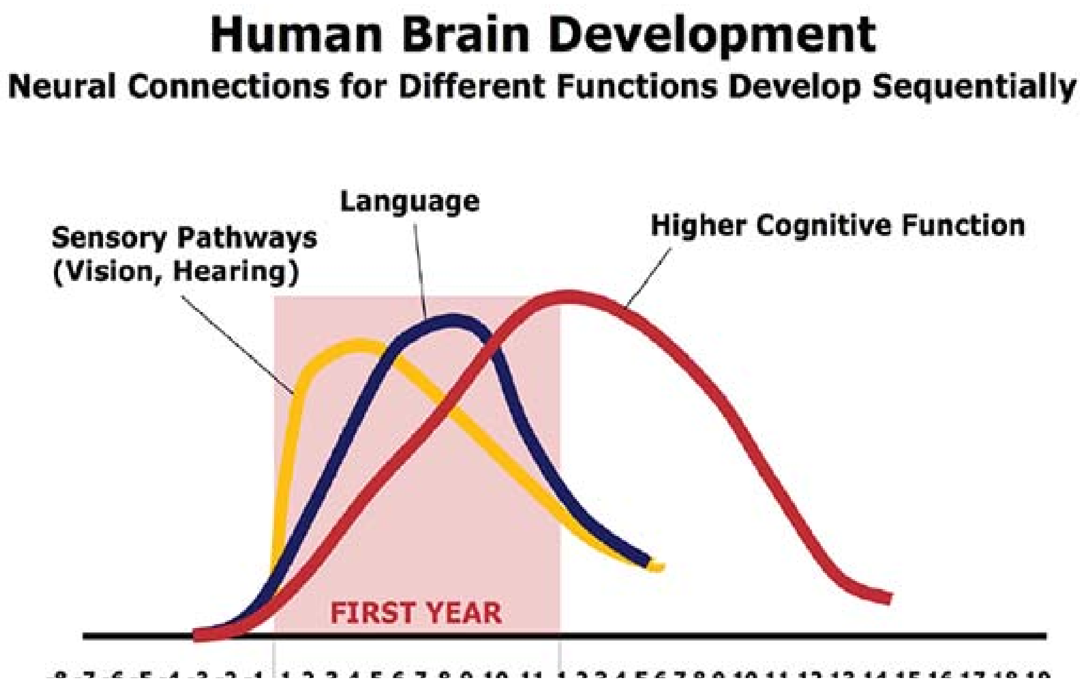


Exhibit 1 Human Brain Development. Note: Reprinted from Center on the Developing Child (2007). The Science of Early Childhood Development (InBrief). Retrieved from www.developingchild.harvard.edu.

Exhibit 1 shows the proliferation and pruning process, showing that simpler neural connections form first, followed by more complex circuits. The timing is genetic, but early experiences determine whether the circuits are strong or weak. Source: C.A. Nelson (2000). Credit: Center on the Developing Child

This is where STEM is relevant. Introducing Stem promotes a better understanding of why it is essential in today society. STEM is an inquiry-based application of sciences, technologies, engineering, and math. It is a concept that has been growing in popularity decades; various forms have been a mainstay in middle schools and high schools. However, it is less prevalent in elementary schools. This has been changing in the last decade, with research and studies providing evidence that elementary aged children process information and revealing correlating benefits of introducing STEM material at a younger age (Center on the Developing Child, 2007). With a firm educational understanding of scientific concepts, everyday skills, such as creative problem solving, critical thinking and teamwork, will set the foundation for continual education (National Science Education Standards, 1996, p. 10).

With this understanding of the importance of STEM, a local elementary school established a STEM lab. The elementary school does not use the lab as much as they desire. They wanted to create a summer STEM program or camp that would bring more visibility to the importance of STEM within their elementary school. They tried to promote teachers' and students' involvement with the summer camp, with the intent that teachers would gain the confidence required to implement STEM into their classrooms.

Background

STEM has been a large part of the American culture since the launch of the Russian satellite, Sputnik, in 1957. During President Dwight D. Eisenhower and John F. Kennedy's time in office, Americans took up the challenge of becoming leaders in science, technology, engineering, and math. Since then, Americans have continued to drive toward the future by encouraging science education. The integration of STEM into elementary school settings are less common that middle and high schools, however, the use of STEM in elementary schools is gaining traction. One such school, a local elementary, has established a STEM lab. The lab currently has no formal curriculum, reducing school-wide awareness and integration. Through observation and information acquired from the few teachers that utilized the lab, the current program would benefit from project management principles and practices.

Purpose

This project will apply project management principles to develop a STEM summer camp curriculum. The summer camp will be the first step for their STEM program, to increase visibility among staff, students and parents. The information gathered from the summer camp will also provide valuable information that will assist the elementary in developing a establishing a formal curriculum following the summer break.

Scope

This project facilitated increased STEM program visibility among educators and students within the school. Annotation of educator survey and interview inputs were used to create a curriculum for a one-week summer STEM program. The project consisted of four phases. Phase one involved assessment of the current program, grade level compatibility, survey creation, dissemination, collection, and analysis. Phase two consisted of stakeholder input related to the current STEM program, obtained through interviews, staff meeting attendance, classroom participation, and observation, along with the survey produced during phase one. Phase three involved creation of a summer STEM program to providing students the ability to maintain an interest in STEM-related academia throughout the summer months, while also preparing students for the following year's academic cycle. The summer program also provided participating educators with the training necessary to implement STEM into their daily classroom curriculum. The summer program consisted of a single one-week session and was held shortly after the schools' summer break. The STEM camp consisted of three rotational stations. Station one consisted of an outdoor STEM exploration lab, station two was be an outdoor STEM lab, utilizing natural materials to test principles of nature, and station three was an indoor STEM lab, using robots and other technologies. Phase four will take the lessons learned from phases one through three, to create a detailed curriculum, specific for each grade level within the school. Phase four falls outside the scope of this project. At the completion of Phase three and project closeout, the project will be turned over to the local elementary personnel for Phase four implementation.

Methods

This project is intended to further the academic use of STEM activities among younger individuals attending elementary school through project management principles. The project took place in a single elementary school, focusing on its students and teachers. The project management knowledge areas used to manage the project were, stakeholder engagement, communication management, and time management. With additional methods and procedures used during the project. They will discuss and primarily focus on the STEM summer program, curriculum creation, along with results and recommendations. Academic research was performed to reference similar project methods and benchmark curriculum.

Group Discussion

Upon approval of the project, a focus group was established to determine the project's scope, requirements, and deliverables. The focus group consisted of the Sponsor, Project Manager, and a Primary Stakeholder. The focus group identified additional stakeholders, their level of interest and influence in the project, along with requirements, issues, concerns, resource estimates and any relevant information. An interest and power grid (exhibit 9), along with an engagement matrix (exhibit 10) were utilized by the group to document each stakeholder's position within the project. Exhibit 9 and 10 provided a reference guide for the stakeholders and the project manager.

Additionally, informal meetings took place bi-weekly, after the initial meeting between the Sponsor and Project Manager. These meetings addressed new concerns, changes, or questions relevant to the project. All meetings were documented in a stakeholder communication log, used to track meeting dates, attendees, topics, and any other relevant data.

All identified requirements for the project were recorded on a Requirements Traceability Matrix (RTM) and prioritized according to the phase in which they would occur as seen in exhibit 2. Requirements were tracked in a requirement register and requirements management plan. Informal discussion information was not documented, resulting in information not being carried forward into the appropriate documents. The topics discussed appeared to have minor influence on the overall project, though proper annotation would have potentially provided the information to make a solid declaration on its relevance on the project.

REQUIREMENTS TRACEABILITY MATRIX

Project Title: Elementary Summer STEM Curriculum **Date Prepared:** 12/07/2018 Revision 1.3

Requirement Information					Relationship Traceability			
RR#	Requirement	Priority	Category	Source	Status	Manifests in WBS Deliverable	Verification	Validation
1	Assess current state of existing STEM program	4	Phase 1	Project Manager	Closed	1.1.1	PM Approval	Status validation
2	Inventory equipment	2	Phase 1	Project Manager	Closed	1.1.1.1	PM Approval	Inventory list
3	Test equipment functionality	5	Phase 1	Project Manager	Closed	1.1.1.3	PM Approval	Successful functional check
4	Create STEM Program Survey	20	Phase 1	Project Manager	Closed	1.1.1.4	Sponsor Approval	Survey Approval
5	Obtain survey submittal approval	20	Phase 1	Project Manager	Closed	1.1.1.4.2	Sponsor Approval	Survey Approval
6	Disseminate survey to Ravenwood educators	15	Phase 1	Project Manager	Closed	1.1.1.4.3	Sponsor Approval	Survey Completion
7	Collect and analyze survey data	15	Phase 1	Project Manager	Closed	1.1.1.4.4	PM Approval	Survey Completion
8	Adjust project timeline as needed based on any new scope changes	8	Phase 1	Project Manager	Closed	1.1.1.4.5	PM Approval	Completion prior to summer
9	Stakeholder Interviews	15	Phase 2	Project Manager	Closed	1.2.1	PM Approval	Adequate data
10	Interview Educators	10	Phase 2	Project Manager	Closed	1.2.1.1	PM Approval	Adequate data
11	Interview students	3	Phase 2	Project Manager	Closed	1.2.1.2	PM Approval	Adequate data
12	Create summer STEM program	20	Phase 3	Sponsor	Closed	1.3.1	Sponsor Approval	Approved Curriculum

REQUIREMENTS TRACEABILITY MATRIX

13	Station 1 Outdoor explorers	15	Phase 3	Sponsor	Closed	1.3.1.1.1	Sponsor Approval	Approved Curriculum
14	Station 2 Outdoor STEM lab	15	Phase 3	Sponsor	Closed	1.3.1.1.2	Sponsor Approval	Approved Curriculum
15	Station 3 indoor STEM lab	20	Phase 3	Sponsor	Closed	1.3.1.1.3	Sponsor Approval	Approved Curriculum

Exhibit 2 – Requirements Traceability Matrix

Participants

With the information obtained from the stakeholder group, further clarification and information obtained from the identified five hundred and two students in grades kindergarten through sixth grade provided. This was accomplished through observation, open questions and interaction within each classroom. Twenty-six teachers with an experience range from 2 to 24 years, spread-out through each grade level, were also observed within the classroom setting. Assistance was provided throughout the observation period when appropriate to elicit further stakeholder information.

Interviews

Interviews were performed when appropriate. Interview questions were situational based. There was no preestablished list of questions. All questions were formed based on the situation in which an interview was conducted. When a teacher was on break, the questions were casual and different among each teacher. Other interviews performed during classroom activates revolved around the current lesson being taught and how STEM could be used. Questions were open-ended to encourage teachers and students to further elaborate upon issues, concerns or requirements relevant to STEM and the summer camp. Additional information obtained through interviews, observation, questions, and classroom interactions were updated as needed in the stakeholder register to further assist in scope creep identification. All new information that impacted the project was evaluated for any change in the level of stakeholder engagement and verified their alignment with the project objectives. Application of this knowledge area was continuously used to gain insight into stakeholder influence, power, and interest levels to appropriately manage those areas during the planning stage of the project. Stakeholder Engagement was measured using exhibit eight and exhibit nine. During project execution, influence, power and interest were continually monitored to ensure stakeholder placement within the respective matrices was accurate.

Stakeholder Engagement

The project manager used information obtained from the stakeholder group to determine each stakeholder’s priority within the project. The primary approach to stakeholder engagement followed the four process steps outlined in Lynda Bourne’s book, Stakeholder Relationship Management: A Maturity Model for Organizational Implementation. The four stakeholder engagement process steps involved: (1) Identification and Assessment, (2) Prioritization, (3) Engagement, and (4) Monitoring. Stakeholder management and stakeholder engagement are synonymous.

The Stakeholder Prioritization Process was used to determine the relative importance of each stakeholder based on their perceived power, proximity and urgency. These assessments combined with the tool to produce a "stakeholder priority index score" for ranking each stakeholder to produce a prioritized list of stakeholders. Each stakeholder was rated with three variables: (1) Power, (2) Proximity, and (3) Urgency. Ratings are documents in the Stakeholder Register under the Prioritization category. The following Exhibits 1 through 6 have was taken from Lynda Bourne's book, Stakeholder Relation Management and outline the variables used to define stakeholders (Bourne, 2009).

The definition of Power used is the ability for an individual or group to change or stop the project or other work permanently. Power is an integer score ranging from 1-4. Exhibit 3 shows the power scoring descriptions used.

Power (1–4)	4: The High capacity to formally instruct change (i.e., can have the project stopped) 3: Some ability to officially guide change (e.g., must be consulted or must approve) 2: The Significant informal capacity to cause change (e.g., a supplier with input to design) 1: Relatively low levels of power (i.e., cannot generally cause much difference)

Exhibit 3 - Power Scoring Description. Note: Adapted from Stakeholder Relationship Management, by Bourne, L., 2009, p. 60, New York, NY: Gower Publishing

Exhibit 4 was utilized to identify the proximity of each stakeholder to the project. Proximity: The degree of involvement that the individual or group has on the work of the team. Proximity is an integer score ranging from 1-4. The following exhibit outlines descriptions of the proximity integer scores.

Proximity (1–4)	4: Directly working in the project (e.g., team members and contractors working on the project most of the time) 3: Routinely working in the project (e.g., part-time members of the project team, external suppliers and active sponsors) 2: Detached from the project but has regular contact with, or input to, the project processes (e.g., clients and most senior managers) 1: Relatively remote from the project (i.e., does not have direct involvement with the project processes)

Exhibit 4 - Proximity Scoring Description. Note: Adapted from Stakeholder Relationship Management, by Bourne, L., 2009, p. 60, New York, NY: Gower Publishing

Urgency: Composed of two attributes – (i) value and (ii) action, combined to produce an overall (iii) Urgency Score. Urgency Value: The measure of the stake each person has in the work or its outcomes. Urgency is an integer score ranging from 1-5. The following (exhibit 5) outlines descriptions of the urgency value integer scores.

Urgency: Value (1–5)	5: Has a significant personal stake in the work's outcome 4: Work's outcome is essential to self or the organization 3: Has some direct stake in the work's outcome 2: Has some indirect stake in the work's outcome 1: Limited or no stake in the work's outcomes

Exhibit 5 - Urgency: Value Scoring Description. Note: Reprinted from Stakeholder Relationship Management, by Bourne, L., 2009, p. 61, New York, NY: Gower Publishing

Urgency Action: The likelihood that the stakeholder will act, positively or negatively, to influence the work or its outcomes. Urgency Action is an integer score ranging from 1-5. The following (exhibit 6) outlines descriptions of the urgency action integer scores.

Urgency: Action (1–5)	5: Will go to any length to influence outcomes 4: Will make a significant effort to influence results 3: May be prepared to influence the outcomes 2: Has the potential to influence outcomes 1: Is unlikely to attempt to influence outcomes

Exhibit 6- Urgency: Action Scoring Description. Note: Reprinted from Stakeholder Relationship Management, by Bourne, L., 2009, p. 61, New York, NY: Gower Publishing

Urgency Score: The urgency score used was the combined score of the value and action scores based on the indexing listed in the exhibit below. The following (exhibit 7) was the description used for the overall Urgency score that consisted of the combined value and action scores.

Urgency: (1–5)	5: Immediate action is warranted, irrespective of other work commitments 4: Urgent action is warranted provided it can be accommodated within current obligations 3: Planned action is warranted within a relatively short timeframe 2: Planned action is justified within the medium term 1: There is little need for action outside of routine communications

Exhibit 7 - Urgency (Overall) Scoring Description. Note: Adapted from Stakeholder Relationship Management, by Bourne, L., 2009, p. 79, New York, NY: Gower Publishing

The power, proximity and urgency score information obtained from the process listed above was then imported into the Stakeholder Prioritization Tool to determine a priority index score that represents the relative influence of each stakeholder at a point in time around the project activity. The priority index score was calculated by applying a weighted score to the assessment of the stakeholder's power, proximity, and urgency (overall) scores. The value of adding a weighted measure was to provide the project manager flexibility in emphasizing or deemphasizing dimensions that were situationally important, providing a more accurate prioritization of stakeholder community around the project activity at a specific point in time (Bourne, 2009).

The weighted score was a factored rate in the relative score. The sum of each score from multiplying the relative scores by their factored weight produced a priority index score. The resulting Stakeholder Priority Index Value was then translated into a priority value. The priority value was utilized as a reference number, aiding in prioritizing each stakeholder according to the level of communication and attention required from the project manager throughout the project (Bourne, 2009).

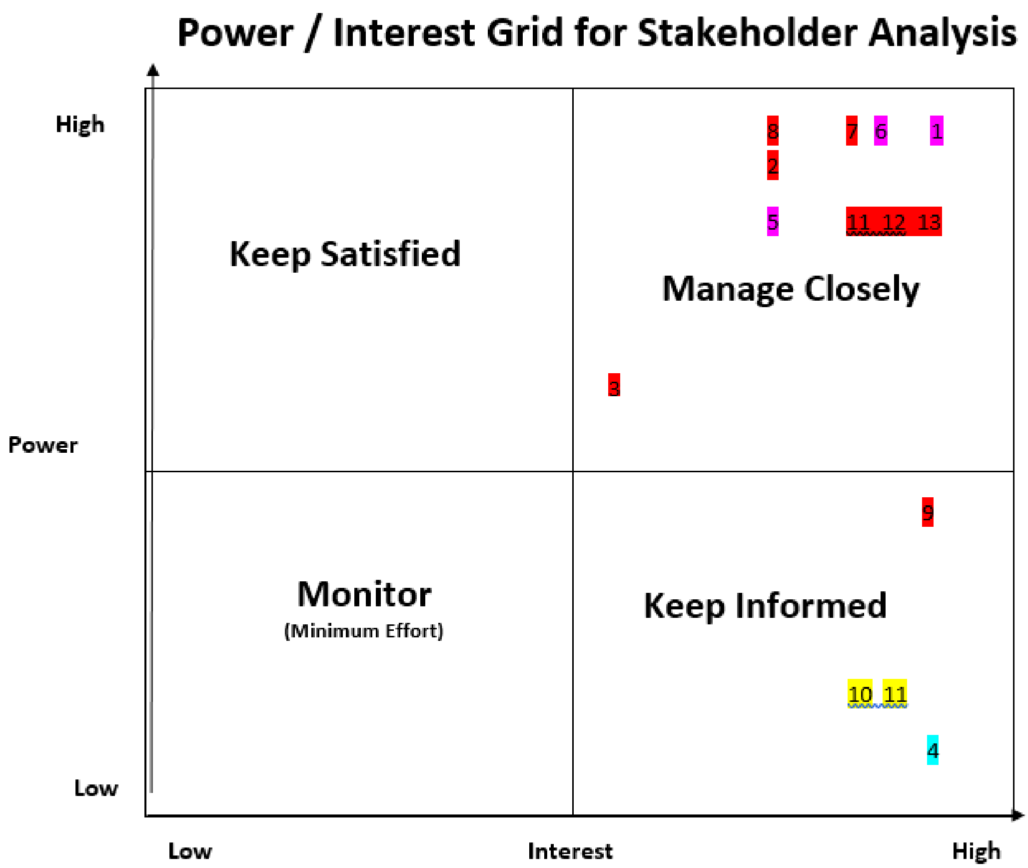
Each stakeholder's priority number was calculated by adding all four values and then rounding. The higher the number calculated indicated, the more critical a stakeholder was and the more attention they needed from the project manager (Bourne, 2009).

	Stakeholder Assessment								
	Elementary STEM Summer Curriculum Project								
Line #	Name	Direction	Role	Significance to Project	Power	Prox.	Urg.	Index	Priority
1	Kim Bautista	U	Oversight	Project Sponsor, CCB Member	4	4	4	52.0548	1
2	Primary Stakeholder #2	U	Project Manager	Primary Work Resource; Self, CCB	3	4	4	47.0448	3
3	Teachers	O	Tester/Trainer	Project Survey Respondents, Product	3	4	4	47.0448	4
4	Students	O	Tester	Product recipient; resource provider	1	2	2	21.0174	6
5	Michael Swann	I	Project Manager	Primary Work Resource; Self, CCB	4	4	4	52.0548	1
6	Luann Piccard	U	Advisor	Product recipient, Committee	4	4	3	46.0541	1
7	Roger Hull	U	Committee Member	Product recipient, Committee	4	3	3	44.0511	1
8	Dr. Kim	U	Committee Member	Product recipient, Committee	3	3	3	39.0411	1
9	Classmates	S	Peers	Project Survey Respondents, Product	2	2	1	20.0267	4
10	Local Residence Taxpayers	O	Parents of students	Students gain experience with	1	1	1	13.0137	10
11	Other local schools	O	Program electives	A successful STEM program to	1	1	1	13.0137	10

Exhibit 8 – Stakeholder Assessment

Exhibit 8 provides a visual representation of data collected through Lynda Bourne's stakeholder engagement methodology above. Power, Proximity, Urgency are used to calculate the index number.

Exhibit 9 – Power and Interest Grid levels of each stakeholder were created during the planning stage of the project. Two grids were used to appropriately segregate the data: Engagement Matrix and Power and Interest grid.



Stakeholder register located in project document repository can be used to identify stakeholders

Color Code
Unaware
Cautious
Neutral
Supportive
Leading

Exhibit 9 – Power Interest Grid

Exhibit 10 – Stakeholder Influence analysis was continuously monitored during the planning and execution stage of the project for any changes in influence and were adjusted as needed.

Engagement Matrix						
Stakeholder ID #	Unaware	Resistant	Cautious	Neutral	Supportive	Leading
1						x
2					x	
3					x	
4				x		
5						x
6						x
7					x	
8					x	
9					x	
10	x					
11	x					
12					x	
13					x	

Unaware: Not aware of the project nor its outcome
Resistant: Aware of the project but does not support it
Neutral: Indecisive about the project and its outcome
Supportive: Feels favorable about the project and its outcome
Leading: Actively engaged in promoting the project

Exhibit 10 – Engagement Matrix

Communication Management

Appropriate and effective communication within the project was an essential part of managing development of the summer camp. Throughout all stages of the project, a continual effort was applied toward sustained communication with stakeholders in an ongoing attempt to help distinguish stakeholder's expectations and influence on the project.

Communication with the sponsor was the primary means of all project priority updates or changes. The original scope of the project was established during the initial discussion, and with this, a scope change was identified as a risk that could occur. The risk was documented in the risk register along with risk response. This risk was realized during a bi-weekly meeting when the sponsor determined that the focus of the project would be shifted to a summer camp for not just its school, but all local schools. The change in focus was documented in the communication log along with the risk response implementation. This realized risk was activated in the project schedule reflecting the change and it was determined that the change in scope did not change the completion date or negatively impact the project.

A change request for the scope summer camp change was submitted and documented in the change log. A change management log was used on this project to document all proper change management actions. Each change order that pertains to the project and its schedule was recorded in the log. If the change order was accepted or rejected, the number was tracked and monitored for an additional metric for scope creep.

An unidentified risk occurred, involved advertising for the summer camp. The sponsor initially determined that no involvement was necessary from the project manager for advertising the camp. During an informal interaction with the sponsor, the project manager was informed that the summer camp might not be able to proceed. Enrollment for the camp was not high enough to validate the expense associated with purchasing supplies, paying staff, and running the camp. It was determined that an attempt to advertise the program within other district schools had to be approved by the school district. A request for approval was not discussed initially until a deadline for the approval request had expired.

However, the elementary school was able to advertise with local private schools. Enrollment from private schools was not enough to keep the project on track. To validate the curriculum developed from this project, low enrollment would have canceled the summer camp, negating curriculum validation. This subsequently was added to the risk register. A risk response required a thorough analysis of the currently enrolled students. Within this realized risk, another unknown risk occurred. It was discovered that the sixth-grade classes were not included among the students that were eligible to enroll. An impromptu meeting with the sixth-grade classes, inquiring how many students would attend the camp if given the opportunity, was approved by the sponsor. The sponsor was informed that the sixth-grade class had over a dozen students that wanted to attend. The risk response was identified, involving opening enrollment to the sixth-grade, yielding an appropriate enrollment number for the project to resume. Without sufficient enrollment, a concern was produced validate the curriculum

A survey was produced and approved by the sponsor for distribution among the teachers within the school. Within a time-frame of two weeks, all surveys were completed. With the realized risk of a change in scope, another unrealized risk occurred. The survey questions were formatted to the project's initial scope. The realization of this risk was not identified until the data required evaluation, well beyond the beginning of the execution phase. Due to the structure of the questions for the initial scope all data obtained was determined to lack relevance for the new scope change. A lesson learned regarding surveys includes a recommendation that surveys on future projects be submitted in multiple stages. This would provide the flexibility to update questions in each remaining survey according to scope changes to increase the probability of usable data for the given project.

Schedule and Time Management

Time management was chosen as a component to track and determine project success. The seven Process, the seven processes in the project time management section of the Project Management Body of Knowledge book, were utilized to produce and implement the schedule. (PMBOK, 2017).

These processes were:

1. Plan Schedule Management
2. Define Activities
3. Sequence Activities
4. Estimate Activity Resources
5. Estimate Activity Durations
6. Develop Schedule
7. Control Schedule

A project schedule was created in Microsoft Project®; with the schedule baseline set before project execution. Tasks were resourced, and activities defined, with the work breakdown structure used for the Activity List. Work Package tasks were sequenced accordingly. Estimated activity durations were utilized for active tasks only; risk response measure tasks were included in the project duration when a risk occurred and activated. When a risk occurred, the risk response trigger was activated, subsequently changing the project duration.

The project began on February 1st, 2018. The planned duration of the project was 128 days, with a project completion date of June 8th, 2018. With realized risks, the project schedule duration was not impacted. The project schedule was reviewed at the end of every week to ensure any slippage or accelerated durations were adequately captured in the schedule. The schedule was also revised as risks occurred or new risks were identified and adjusted according to the risk response. Identified risks were identified and entered into the schedule in sequence with the task that would be affected by the risk. Each identified risk was inactive along with its corresponding response for risk response implementation. As risks occurred, they were activated in the schedule, and the response length were updated according to estimated risk response duration impact. The schedule was also reviewed for deliverables that affected the project duration causing slippage. Had a task been identified as slipping, communication with the sponsor would have taken place to determine appropriate acceleration methods.

Scheduled tasks entered into the schedule, had started and finish dates that were auto-calculated. Task start, and finish dates were determined according to the needs of the sponsor and baseline. The sponsor provided estimated dates for each task and was not concerned with any of the tasks not being accomplished within the given timeframe. Apart from the survey creation and dissemination, all other tasks had considerable date flexibility. The sponsor expressed that all tasks needed completion before the summer camp opening day on June 4th, 2018.

The baseline was utilized as a time management metric. Maintaining a Schedule Performance Index (SPI) of .90 or higher was the predetermined value threshold for change implementation due to the flexibility of task duration. Through the process of project implementation and execution, the performance index was not utilized as a metric for change as predetermined. With the flexibility of the task durations, risk responses implemented and scope change from the initial scope to the summer camp, the project manager neglected to refer to the project schedule performance index during the project. This was an oversight by the project manager and ultimately did not impact the end product. The same occurred for the Schedule variance (SV) which was expected to be utilized for determining schedule compliance.

Discussion

The findings for the research and project management principles yielded less than the desired result. Application of these principles illustrated on the difficulty involved with stakeholder management and engagement. Metrics for each portion of the project were chosen to gain sufficient data needed to complete the project within the sponsor's timeline.

The initial observation of the elementary STEM program resulted from an invitation to the project manager to attend an evening class. The elementary had a STEM lab established the prior year; however, it was underutilized by students and staff. A small number of teachers tried to use the STEM lab after school hours. They provided a three-week class for students to receive exposure to STEM-related materials. The teacher's overall intent was that through the principles of STEM, students would enhance current communication skills and critical thinking skills, that would translate into their classroom. Through attendance of a few after-school STEM labs, it was observed by the project manager that no formal curriculum was in place for the lab that could be followed by the teachers. The project manager contacted the principal which is also the sponsor regarding the lab and the direction the school was attempting to take the STEM program. It was made clear that the program was not a school district program and STEM was not currently a component in the standardized elementary curriculum.

The sponsor wanted to increase the visibility of STEM within their school and all the elementary schools in the district. The initial project involved a complete overhaul of the current STEM lab. The main components involved inventory, assessing and creating a curriculum. The curriculum would be tailored to each grade, encompassing all educational materials specific to each grade. During the second meeting with the sponsor, it was identified that a summer STEM camp was also planned. The initial scope of the project was determined to be too broad. The scope of the project was then focused directly toward the summer camp and the steps involved to get the camp going. This would provide information for the school to further understand and implement a curriculum for their STEM lab the following year.

Along with the change in scope, it was also discussed and determined that no adjustments pertaining to the methods of data collection and its analysis were necessary. This scope change allowed all data collection methods; interviews, survey, observation and participation to be carried forward. The methods of data collection and data obtained was used to produce the STEM summer camp and its curriculum. The exhibit 10 below, shows a diagram of the initial scope's requirements being carried forward to the changed scope.

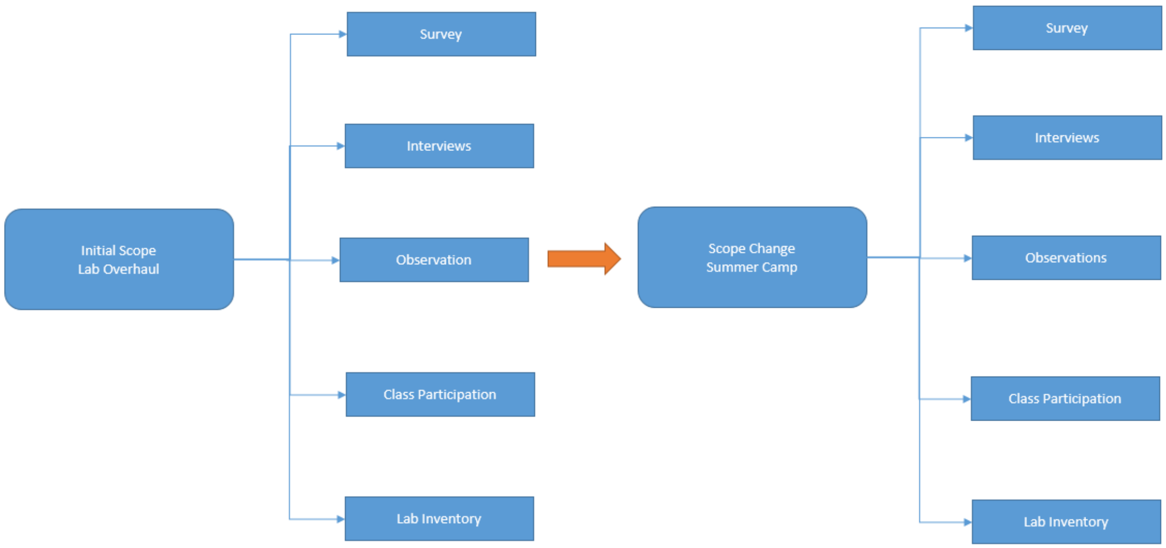


Exhibit 11 – Scope Change

A stakeholder group was assembled and included the sponsor, project manager, and the primary stakeholder. Through this meeting, project goals, objectives and deliverables required to accomplish the project were determined. Additionally, stakeholders were identified along with an estimated list of requirements for each stakeholder. The estimated list for the stakeholders provided the project manager with a point of reference for interview and survey questions. The requirements identified to complete the project were entered in the project schedule.

A realized risk occurred involving a scope change. This triggered a risk response. The project manager activated the risk along with the risk response task. The risk response involved re-estimating new tasks required through a formal meeting. A determination was made, that the change would only reduce the number of sessions for the STEM summer camp. This reduction eliminated Phase Three B, which involved a second summer camp session taking place the last week of summer. The result of the implemented change and risk response produced a schedule with a decrease in the overall completion date of the project. The difference in scope arose from an unforeseen risk manifested in an inability to verify enrollment for the second session. Upon establishment of the STEM summer camp project, letters were sent home with each student to determine potential enrollment. The sponsor discovered that enrollment would not be high enough to proceed with the second session.

The project manager was tasked with the design of the STEM camp curriculum. The initial process involved verification of stakeholder needs and requirements. A survey was determined to be the primary data collection method for each teacher. The survey would allow teachers to provide responses and comments with anonymity. The survey was researched and populated with questions relevant to assessing teacher comfort, access and use of the current STEM lab that were created based on the needs of the project. Such questions as, “How often do you use STEM in your curriculum?” and “What is your opinion of the use of the current STEM lab?”, were among the questions on the survey.

The survey was submitted to the sponsor for review and required two revisions before approved for submittal. The sponsor took responsibility for survey submittal and guaranteed that all teachers would complete the survey. The survey was submitted to the twenty-six teachers, with fourteen of the surveys obtaining a one hundred percent completion rate. Eight teachers completed on average seventy-five percent of the survey while the remaining four, completed thirty-five to fifty percent of the survey.

Collected data echoed data discovered through literature review. The majority of respondents indicated they felt the most critical challenges facing STEM education are the lack of professional development of STEM teachers, funding in K-12 STEM education is insufficient, and an inadequate number of STEM-qualified teachers. Another area mentioned by one of the survey participants that may be considered for future research would be the mass-produced curriculums (such as Common Core) that ASD has purchased which do not allow teachers the flexibility to utilize STEM lab. One teacher stated, “We are bound by these overbearing curriculums.” One question from the survey highlighted the use of the STEM material within the school.

While reviewing the survey data, another unforeseen risk was realized. The survey was not structured and populated in a manner that would elicit relevant responses. The data obtained did not provide enough significant information for analysis and as a result was eliminated from inclusion. The questions were not specific for a summer STEM program. The questions pertained to teacher knowledge and use of STEM and the desire for training in STEM-related materials. Teachers did express that the current educational standards limited the capacity to provide the time necessary for STEM use within the classroom. With this, they also revealed the lack of familiarity with STEM materials and how to apply its methods to the current curriculum. However, a majority of the teachers did express that, given the time and training, they would be receptive to its use.

A lesson learned from the survey information identified that the anticipated data would not be produced. This was a result of the questions lacking specificity related to the adjusted scope. Recommendations would involve surveys being provided at different stages of the project, individually; would have increased data collection. This would have allowed for an error in the questions to be identified and tailored to be more specific for the STEM summer camp. The survey also contained far more questions than a typical recommended number of around fifteen. This resulted in nearly half of the teachers submitting incomplete surveys. The questions could have been restructured to obtain the same information while reducing the overall number of questions and the resulting fatigue generated by the length of the survey.

Another lesson learned pertains to the survey question creation and its dependence on interview data. The survey was created and submitted before any interviews were accomplished. The survey was established on information obtained from the sponsor. This allowed a single stakeholder's information to dictate the direction of the questions. This risk was not identified until the survey data was collected for analysis. It was determined that this was another unforeseen risk that required a response. Unfortunately, by the time the survey data was received, the only action that could be taken was to eliminate the survey from the project along with its data. Subsequently, the project schedule lacked sufficient time to produce, review, submit, and analyze the data from a new survey.

While the survey was being taken by each teacher, the project manager spent time with all the teachers in their classrooms. Each class provided a snapshot of the level of performance among each student and teacher. It provided an understanding of which classes utilized STEM materials and methods. Out of the twenty-six teachers observed, nearly twenty of them mentioned the style of the curriculum to which they were required use. The school has a platooning style curriculum in place, which is a system that has students rotate between classrooms to learn different subjects. This allows students to learn each subject from a specialized teacher, providing more focused instruction on the given subject. Platooning requires more time for each teacher since some subjects have more flexibility in the manner in which material is delivered to students. With this limitation imposed on some teachers, they could not incorporate STEM into their curriculum, in conjunction with self-educating themselves on STEM use in the given subject.

Interviews also were a form of data collection utilized. They were performed throughout the project, through the last week of school. Interviews were conducted in an informal setting, typically in the teacher lounge or during their break. No formal interview questions were not established. Questions were open-ended to elicit answers that were unconstrained. Typical questions would involve current STEM use, its familiarity and what their thoughts were about after-school programs. A question that was asked to all interviewees was "do you think that a summer STEM program would improve visibility for the STEM program?" Most teachers felt indifferent to this question. A few said that it would, but not enough to change the school district's policy regarding its implementation into the class curriculum.

The interviews produced another unidentified risk. The questions were not specific enough, nor the majority of them directed toward the summer camp. Similar to the data for the survey, it was determined that the question data was not sufficient to provide useful information to aid in the summer camp design. This lesson learned from the interviews would require any future interview to have specific questions that all interviewees would be asked. This would yield a consistent set of answers.

Throughout the school day, students were observed in the classroom setting. Observation occurred concurrently with interviews at all grade levels. It was noted that though some teachers indicated through interviews that they did not use STEM in their classroom, it was present. A few teachers would have student break off into groups and complete an in-class assignment. One such teacher had second-grade students perform a construction project. This involved each group receiving a given amount of money. They had to build a structure that would withstand a windstorm, earthquake, and flood. Each group had to decide on a design, a list of materials and who would be performing most of the building assembly. Each group had drastically different plans, all while enjoying the entire process. Each group showed signs of teamwork and cooperation. In the end, each group had their building submitted to a blow dryer for wind, table movement for earthquake and water poured on the structure. The teacher had been doing this type of activity when the class was ahead of schedule for years.

Though STEM is an interdisciplinary method of education, finding a way for these teachers to focus primarily on the subject they were teaching was also challenging unless teachers from different subject collaborated. Like, the class with the group building project, another class was observed performing an activity in the STEM lab for their first time. One such collaboration involved two-second grade teachers using the Dash robot for social studies and geography lessons. These two teachers took time out of their personal lives to learn the functionality of the Dash robot, brainstormed and experimented with how they could be utilized to educate their student. They set up a scaled down version of downtown Anchorage and had students construct iconic landmarks. These students were broken up into groups of four and they would then spend time learning how to code each Dash robot. Each student in the group was responsible for an equal portion of the project. Their assignment was to take a specific path through the scaled-down version of Anchorage. Along the route they chose, they had to code the robot to stop at a number of the iconic locations and provide a description of each location before returning to the original starting position. This and a few other observations allowed the project manager to participate in the classes.

Observation and participation provided a foundation for curriculum design for the summer camp. The research was performed for each rotational section of the summer camp. The curriculum creation deliverable was nearing completion toward the end of the school year, during teacher interviews. These interviews intended on finding three teachers willing to teach during the summer camp. After teacher selection, the sponsor informed the project manager that each teacher was designing their curriculum. This was another unforeseen realized risk. The design process was handed over to the selected teacher, and the project plan was updated accordingly.

The curriculum created for the summer camp was used as a reference by each teacher to aid in their curriculum creation. It was used as a template for a schedule to assist in their curriculum selection based on time allotments for sessions and lunch periods. Additionally, an estimated sixty percent of the research-based curriculum created through the project was also utilized by the teachers. The remaining forty percent of each teacher's curriculum was established based on their knowledge of education and activities that they desired to accomplish and found interesting. This produced an additional lesson learned. Teacher selection in the early stages of the project would have aided in identifying stakeholders responsible for curriculum design. Earlier screening may have yielded more time and focus directed towards other areas of the project.

Establishment of a curriculum involved research into standards on the correct method to create a curriculum. Existing summer camp standards and curriculums were referenced to establish a benchmark for curriculum creation.

Anne Jolly points out that no two curricula are the alike and will be dictated based on each teacher and subject. She states that stem lessons should be geared towards some standard specifications (Jolly, 2018).

These Specifications were

1. Does the lesson present a real problem (an engineering challenge)?
2. Will students relate to the problem?
3. Does the lesson allow students multiple and creative approaches and solutions for solving the problem?
4. Does the lesson integrate and apply important science and math grade-level content?
5. Does the lesson intentionally use the engineering design process as the approach to solve problems?
6. Does the lesson us a student-centered, hands-on teaching and learning approach?
7. Does the Lesson lead to the design and development of a model or prototype?
8. Is the role of technology in the lesson clear to the student?
9. Does the lesson successfully engage students in purposeful teamwork?
10. Does the lesson include testing prototypes, evaluating results and redesigning to improve their outcome?
11. Does the lesson involve students in communicating their design and results?

These specifications were used as the benchmark for the summer camp curriculum. They provided guidance regarding lesson identification specific to its application for each grade-level and relevance to each student. Classroom observation provided additional guidance into each grade levels abilities and aptitude. All activities researched and chosen were selected on the bases of their ability to be understood and accomplished by similar age and grade levels, such as first and second grade. Grades first and second were the first group and attended each station together. Group two comprised of third and fourth grade, while fourth and fifth grade were group three. The curriculum was created with two main components in mind. Hands-on activities and the freedom for each student to perform each activity however they saw fit.

The schedule was broken up into fifty-minute sessions with ten-minute transition times. The ten minutes allowed for the students to clean up the activity area and move to the next activity station. Lunch took place after the first round of sessions. During the lunch hour, students would be able to go outside and play on the playground or participate in additional hands-on activities. One such activity was a vinegar volcano. All the students showed interest in the volcano and they would stop playing long enough to give it a try. Two students however from the sixth grade started to help other students with the methods and procedures in creating their volcanos. This provided a display for the sponsor and the teachers that the students wanted to participate in such activities even in their spare time. It also showed that students were also willing to sacrifice their leisure time to help others. This is a large part of what STEM is about. Helping others through shared experiences and joint communication.

The use of MS Project was relatively straightforward regarding data entry, such as tasks, resources, dates among others. While referring to the schedule during the project, references to schedule performance index (SPI) and schedule variance (SV) failed to be utilized as a metric for change indicators as predetermined. This did not stop the project from proceeding; however, future projects would benefit from taking advantage of these tools. Upon further reflection on the project progression, the schedule was not utilized to its fullest potential. This lack of broad utilization came from the project manager's inaccurate assumption and misconceptions regarding its ease of use. A future project would stand to benefit from further knowledge and improvements regarding this scheduling tool and its impact on the success or failure of a project.

Stakeholder management proved to be more difficult than initially estimated. Lynda Bourne's Stakeholder Engagement method was adopted to facilitate stakeholder management. This, however, may have been an issue for this specific project. The project lacked a large enough pool of stakeholders to allow this method to be utilized to its fullest potential. This was also compounded by the lack of experience regarding the project manager. A lesson learned would involve an appropriately experienced project manager utilizes the use of such a powerful tool. Using the tool did yield more insight to each stakeholder, but this tool was a project in itself, learning how to understand and apply appropriately for this project. Starting with a metric more appropriate for smaller projects would have yielded proper data collection. Through the use of relevant metrics, the project manager would have the ability to apply more robust methods or metrics when identified.

Risk assessment and identification was a continual process through the project and included risk identification, evaluation and prioritization. Risks were tracked on a risk register and updated when a new risk was identified. Risk mitigation includes developing risk contingency and mitigation strategies, as well as monitoring the impact of the issue, action items, strategies and residual risks. The Risk Management Process can be found below as exhibit 11.

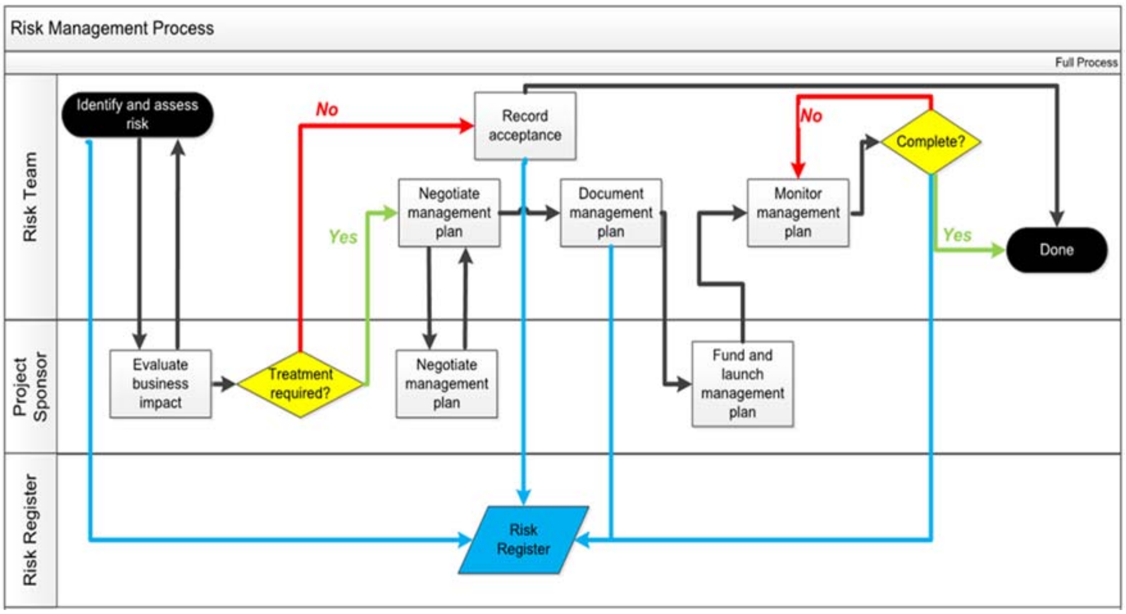


Exhibit 12 Risk Management Plan. Note: Resource Unknown

With all the risks and challenges that occurred, the summer STEM camp remained on schedule and launched on June 4th, 2018. Each teacher selected to run the camp produced their curriculum that provided the desired result for the sponsor. Each child that enrolled was able to have an interactive, hands-on experience. The outdoor lab focused on materials that are produced by nature, such as leaves and sticks. Physical properties such as gravity, buoyancy, kinetic and potential energy were also used to explain scientific principles. Classes would start with students walking the trails around the school to collect materials. They would then build objects such as rafts out of the materials collected. They were then challenged to make a raft that would float under the weight of rocks. They would test their creation and adjust the design as needed. The following day they would build a sail for the raft and see how far it would go. Another class involved a Sphero robot and its ability to do work.

A class on erosion was popular. Tables were set up to allow water to flow from one container to the next. Food coloring was added to shows the path of the water and where it was the fastest. Projects like these allowed the children to experience the world around them while focusing on problem-solving skills. They experienced teamwork and helped each other willingly. Older students would help the younger students with concepts that they did not fully understand. They would find a way to explain a concept to their peers on occasion, better than the teacher. The teachers indicated during an informal closeout briefing that they were able to learn from the experience as well. They were able to see the concepts of STEM at work and how each student excelled when given the opportunity to apply skills and knowledge creatively.

Conclusion

The summer program was the first step towards a strong STEM program within the school. The students that attended the summer program and the teachers have furthered the application abilities of STEM in an elementary school environment. The students will share their experience with their parents, friends, fellow students, and teachers. This along with the teachers that participated in the summer program will increase visibility and help aid in perpetuating the importance of STEM among younger students. The teachers that participated in the summer program have been empowered to advocate STEM within their school and classrooms. This empowerment will allow these teachers and other to further educate themselves on integration of STEM concepts into the current curriculum.

STEM is not a new concept but has yet to become a standard for education. Hands-on implementation of problem-solving skill through real-world application has a place in elementary settings. The hope is that policy will evolve to provide teachers with the information and training needed to create and foster an environment for student collaboration, practical application, and critical thinking skill improvement. Through this project, the school will be able to establish a robust curriculum and offer STEM programs each summer. Each summer STEM program will improve upon the previous summer's program and continue to provide students with a method of exploring the world around them, outside of the classroom setting.

Realized risks, either identified or unidentified, further increased the importance of proper risk evaluation and mitigation methods. Through the risks that did occur, unknowns were produced, also improving project management skills. All realized risks ultimately did not result in project cancelation. The risks and their responses did, however, cause the project manager to reevaluate the tools and principles used. Through experience and application of industry tools, future projects may have a far better chance of succeeding. Several lessons learned have been produced from this project and the use of stakeholder management, communication management, and time management principles. Future projects should be carefully evaluated for more appropriate tools and their proper application. The school has committed to use the lessons learned and curriculum as a foundation for future summer camps. Lessons learned from this project were provided to the elementary school to implement and improve the current STEM program and it was successful.

Recommendations for Further Research

Potential future research could be a further investigation into the current policies in place that restrict or limit the implementation of STEM-focused curricula in schools, specifically elementary. Additionally, what are the methods involved and how would STEM be integrated uniformly nationally?

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Appendices A

STEM Summer Camp 2018						
Daily Schedule						
Day/Time	Group #	Monday	Tuesday	Wednesday	Thursday	Friday
7:30am-8am	All	Student arrival	Student arrival	Student arrival	Student arrival	Student arrival
8am-8:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
8am-8:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
8am-8:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
9am-9:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
9am-9:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
9am-9:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
10am-10:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
10am-10:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
10am-10:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
11am-11:50	All	Lunch	Lunch	Lunch	Lunch	Lunch
12pm-12:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
12pm-12:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
12pm-12:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
1pm-1:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
1pm-1:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
1pm-1:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
2pm -2:50	Group 1	Station 1	Station 1	Station 1	Station 1	Station 1
2pm -2:50	Group 2	Station 2	Station 2	Station 2	Station 2	Station 2
2pm -2:50	Group 3	Station 3	Station 3	Station 3	Station 3	Station 3
3pm-3:30	All	Student Pickup	Student Pickup	Student Pickup	Student Pickup	Student Pickup

Group 1 = 1st and 2nd graders
Group 2 = 3rd and 4th graders
Group 3 = 5th and 6th graders

Appendices A – Summer Camp Curriculum

Appendix B

Station Curriculum									
	Monday	8am-8:50		Monday	9am-9:50		Monday	10am-10:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Rafts	Print Casting	Dash Intro	Rafts	Print Casting	Dash Intro	Rafts	Print Casting	Dash Intro
Group	1	2	3	3	1	2	2	3	1
Lunch 11am - 11:50									
	Monday	12pm-12:50		Monday	1pm-1:50		Monday	2pm-2:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Lego Dam	Bottle Car	Dash Programming	Lego Dam	Bottle Car	Dash Programming	Lego Dam	Bottle Car	Dash Programming
Group	1	2	3	3	1	2	2	3	1
Tuesday									
	Tuesday	8am-8:50		Tuesday	9am-9:50		Tuesday	10am-10:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activit	Rafts	Casting	Sphero	Rafts	Casting	Sphero	Rafts	Casting	Sphero
Group	1	2	3	3	1	2	2	3	1
Lunch 11am-11:50									
	Tuesday	12pm-12:50		Tuesday	1pm-1:50		Tuesday	2pm-2:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Rescue Device	Popsicle	Sphero Painting	Rescue Device	Popsicle	Sphero Painting	Rescue Device	Popsicle	Sphero Painting
Group	1	2	3	3	1	2	2	3	1
Wednesday									
	Wednesda	8am-8:50		Wednesda	9am-9:50		Wednesda	10am-10:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activit	Viscosity	Osmosi	Hot Ice	Viscosity	Osmosi	Hot Ice	Viscosity	Osmosi	Hot Ice
Group	1	2	3	3	1	2	2	3	1
Lunch 11am-11:50									
	Wednesda	12pm-12:50		Wednesda	1pm-1:50		Wednesda	2pm-2:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Block the Water	Station 2	Water Slide	Block the Water	Simple Winch Machin	Water Slides	Block the Water	Simple Winch Machin	Water Slides
Group	1	2	3	3	1	2	2	3	1
Thursday									
	Thursday	8am-8:50		Thursday	9am-9:50		Thursday	10am-10:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Snap Circuits	Erosion	Electric Potato	Snap Circuits	Erosion	Electric Potato	Snap Circuits	Erosion	Electric Potato
Group	1	2	3	3	1	2	2	3	1
Lunch 11am-11:50									
	Thursday	12pm-12:50		Thursday	1pm-1:50		Thursday	2pm-2:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activit									
Group	1	2	3	3	1	2	2	3	1
Friday									
	Friday	8am-8:50		Friday	9am-9:50		Friday	10am-10:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activit	Hike	Hike	Hike	Hike	Hike	Hike	Hike	Hike	Hike
Group	1	2	3	3	1	2	2	3	1
Lunch 11am-11:50									
	Friday	12pm-12:50		Friday	1pm-1:50		Friday	2pm-2:50	
	Station 1	Station	Station 3	Station 1	Station	Station 3	Station 1	Station	Station 3
Activity	Hike	Hike	Hike	Hike	Hike	Hike	Camp Video	Camp Video	Camp Video
Group	1	2	3	3	1	2	2	3	1

Appendices B – Summer Camp Curriculum